



COLONY AND PROTECTORATE OF SIERRA LEONE

ANNUAL REPORT
OF THE
Department of Agriculture
FOR THE YEAR
1946

Price 1s. 6d.

FREETOWN :

PRINTED AND PUBLISHED BY THE GOVERNMENT PRINTER, SIERRA LEONE
*To be purchased from the C.M.S. Bookshop, Oxford Street, Freetown, and from the Crown
Agents for the Colonies, 4 Millbank, Westminster, London, S.W. 1.*

1948



The Annual Report of the Department of Agriculture for 1946

SIR,

I have the honour to submit my report for the year 1946.

SECTION I—INTRODUCTION AND POLICY

During 1946 much was achieved to get the various branches of the department back to their normal duties which had of necessity been neglected during the war period. The resumption of normal experimental, research, and extension work is an essential preliminary to the inception of the post-war development programme which it is intended should begin to show results in 1947. Progress is being hampered to some extent by the lack of certain specialist staff and the difficulty of obtaining equipment.

2. Special attention was given, with good results, to the resuscitation of rigid inspection of export produce. Comprehensive new legislation was introduced and additional staff taken on for training in inspection work. Concurrently, instruction was given to farmers in correct methods of preparing produce for market.

3. Good progress was also made in connexion with the general development of swamp lands for rice farming and market-gardening. Particularly encouraging is the increased interest which many Native Administrations are taking in agricultural development. Several new Native Administration seed and demonstration farms were established under the supervision of the Agricultural Officers who are also training Native Administration staff to take charge of the seed farms and to undertake general extension work among the local farmers. Another promising development was the clearance of two inland swamps in the Northern Province and the allocation of lots to local upland farmers for rice and vegetable cultivation. Security of tenure and the payment of an economic rent to the Native Administration are provided for. The project is working well and it is hoped to extend it widely using Native Administration funds for the initial cost of clearing and laying-out the land prior to settlement.

4. The need for maximum production of rice and other food crops for local consumption continued. It was an excellent year for all food crops, and the production of rice—the staple crop—was definitely above normal. Important contributory factors were the very favourable weather, and the return to farming of many men who had been in the army or who had been employed in non-agricultural work during the war period. The distribution of seed of swamp rice and of seed and planting material of a large variety of subsidiary food crops was continued under departmental and Native Administration schemes.

5. There has been no change in the general policy of the department although it is probable that some variation in emphasis will be necessary to conform with changing requirements. The following is a summary of the approved policy and the more important work initiated or extended during the year:—

A.—THE ADEQUATE PROVISION OF FOOD FOR THE PEOPLE

This is to be accomplished by:—

1. *The improvement and spread of swamp rice cultivation to such an extent that not only will the needs of the people be supplied in a bad year but there will be a surplus for export in ordinary years.*

Work initiated or extended in 1946:—

(i) *Mangrove Swamp Reclamation.*—In the southern coastal mangrove areas the clearing of mangroves, the establishment of new farms, and the consolidation and expansion of existing farms continued steadily and well. During 1945 advances to new farmers were purposely restricted and work was concentrated upon improving already established farms. During 1946 work was speeded-up, particularly in Bonthe District, and concentrated in the most responsive and progressive chiefdoms. This policy has paid in ease of supervision, and in minimizing failures. On all mangrove-cleared farms the rice crops were excellent whilst there was little trouble from salinity or flooding. In these areas there appears to be no need for bunding, drainage or other systems of water control. The only possible danger is that erosion might take place at the edge of the rivers as a result of the removal of the protective fringing mangroves; and, wherever the banks are subject to wash, farmers are being encouraged to leave a strip of mangroves at the river edges. During 1946, loans were advanced to 135 new farmers who cleared an estimated 400 acres of mangrove. The total number of farmers now established with the assistance of loans since the scheme first began in 1939 is 1,087. They are estimated to have felled and cleared about 5,000 acres of mangroves, of which some 3,500 acres is now being used for rice. In addition, many farmers have, on their own initiative, extended their farms or made new clearings. It is estimated that 150 men, independent of loans, have cleared some 600 additional acres, and this natural extension appears to be gathering momentum. Considering the arduous nature of the work, with every operation having to be done by hand, the remoteness of the area and the difficulty of establishing homes there, this result is most encouraging. Another factor militating against more rapid expansion of the scheme is the traditional unwillingness of farmers to leave their upland farms until compelled to do so by force of circumstance. The under-population of the mangrove areas remains. Gradually, however, as the excellence of the crops, the high fertility of the soil and the general absence of weeds on the established farms become more widely known, farmers from the uplands can be expected to move into the mangrove areas in increasing numbers.

In 1938, Mr. G. M. Roddan, in his proposals for the development of the southern mangrove areas, estimated that some 137,000 acres of mangrove swamps suitable for rice growing existed there. There is no reason to change this figure. In full production this acreage of highly fertile soil could absorb some 34,000 farmers and produce annually up to 60,000 tons of paddy. Mechanical aids to mangrove felling or to cultivation on this saturated soil do not seem possible, and large scale development using hand methods for clearing and cultivation seems the only solution. Adjoining the mangrove areas, mostly along the Bum-Kittam riverain District south-east of Bonthe, are some 70,000 acres of grasslands suitable for rice if flood-damage can be controlled. Here, again the population is sparse and only a small fraction of the area is cultivated, entirely by hand. Mechanized cultivation, particularly in the dry season, may be feasible in these grasslands and it is only by some such method that development could be accelerated. This possibility will be investigated.

(ii) *Saline Swamp Reclamation.*—The experimental cultivation of rice which was started in 1945 on empoldered cleared mangrove swamp at Wellington near Freetown was continued. Although one test plot gave the excellent yield of 54 bushels per acre other plots were partial or complete failures. The cause of failure was toxicity which is increasing in intensity in the parts of the polder which were previously under *Rhizophora* mangrove. Every effort is being made to solve the problem, but until a solution is found it will not be possible to justify any expansion of our programme to reclaim saline mangrove swamps.

(iii) *Inland Swamp Cultivation*.—The fundamental policy of the department to encourage the maximum use of the large areas of freshwater inland swamps, for rice in the wet season and for other crops in the dry season, continued to give good results. Whilst there is still a long way to go, it can be said that inland swamp rice growing has become an outstanding feature of Sierra Leone agriculture and is expanding visibly year by year. This is being accomplished under the most endurable incentive of all, namely the genuine interest of the individual peasant farmer who adopts swamp rice farming of his own initiative because he knows it is profitable to do so. A test census of swamp rice farmers in 1946 in two districts only, Bo and Pujehun, showed almost 4,000 such farmers. Reports from other areas all indicate similar expansion.

In the Bombali and Karene Districts, the scheme formulated at the end of 1945 whereby money was advanced for the initial clearance of suitable swamps was put into effect during 1946. £400 was provided and 55 acres were cleared at Kamakwie and Makali and rented to farmers in 1-acre lots, the rents being paid to the Native Administration. The scheme is established on sound lines and shows every promise of further expansion. An additional £300 has been provided for further clearing in 1947 and there are signs that other districts intend copying the idea. Basically this inland swamp clearance scheme is similar to the mangrove clearing scheme in that capital is provided to meet the preliminary comparatively high clearance costs. The difference lies in that, in the mangrove areas loans are advanced to individual farmers who repay over several years to Government, whereas in the Northern Province scheme the Native Administration collects annual rents to repay cost of clearance. This thus puts the responsibility of money collection upon the farmers' own Native Administrations and relieves agricultural staff of all responsibilities other than technical advice and supervision. At present, under the Mangrove Loan Scheme, the Agricultural officer and staff, being responsible for loan collection, spend a disproportionate amount of time on work which should be undertaken by the Native Administration.

(iv) *Swamp Rice Seed Distribution*.—With ample supplies of good quality swamp rice seed now in the hands of most farmers, as a result of steady distribution of improved varieties in past years, the departmental revolving seed scheme has been reduced to the minimum. Native Administrations and farmers themselves are now increasingly responsible for seed supplies, the department only issuing a limited amount of high grade pure selected seed. In 1946, 4,219 bushels were distributed. Since swamp rice seed distribution was started the following quantities have been distributed:—

BUSHEL (60 lb.)			
1935	...	...	90
1936	...	...	1,441
1937	...	...	2,082
1938	...	...	2,572
1939	...	...	3,275
1940	...	...	4,064
1941	...	...	6,435
1942	...	...	12,774
1943	...	...	21,835
1944	...	...	23,477
1945	...	...	11,215
1946	...	...	4,219
Total ...			93,479

} Departmental distribution only.

} Departmental and Native Administration distribution.

II. The better cultivation of inland swamps and valleys for rice during the wet season and crops other than rice during the dry season.

In addition to the five main Government farms there are five sub-stations, eight Native Administration demonstration farms and twelve Native Administration seed farms throughout the country. All these farms are to a large extent concerned with the better development of inland swamps whether it is the study of swamp grasses at Njala, market-garden crops at Newton, swamp rice at Rokupr, general intensive mixed farming at Makeni, and also, as at the majority of sub-stations and Native Administration farms, the introduction and multiplication of planting material of the best kinds of swamp rice and dry season crops. The general widespread expansion during the past decade of sweet potatoes, cassava and vegetables, grown in swamps during the dry season, has been a most noticeable result of this work. Success in one promising line of dry season swamp crop, started in 1945, is still elusive. This is Nigerian onion. Trials in 1945 and 1946 showed that this crop grows well at all stations but despite the fact that the crop was grown under varying conditions of climate soils, and time of planting, no seed has yet been produced. The advice of the Nigerian Agricultural Department is being sought in a further attempt to get the right technique and the right locality to enable seed to be produced in Sierra Leone. There is no question that if seed could be produced within the country a flourishing local industry could be readily established. As it is, the only onion grown in Sierra Leone is a small shallot, highly valued and in comparatively short supply. Large onions have to be imported, are very expensive and often scarce.

III. - The extension of garden and small field crops to serve as an auxiliary food supply.

Market gardening in the Colony area had a temporary setback when services demands slackened after the end of the war, but the majority of producers appear to have readjusted themselves and there is no noticeable decrease in production. The market in Freetown for native and European vegetables and fruit is still large. Further extensions in market gardening were in evidence during the year in the Kaffu Bullom area opposite Freetown, and at Kabala, north of Makeni. At Kabala, in addition to African farmers two Syrians started irrigated vegetable production. The enterprise developed at Bo in 1945 by women market-gardeners, whereby vegetables were supplied to Freetown, continued to flourish.

IV. The selection (or introduction) and distribution of seeds and plants suitable for I, II, and III.

New rice varieties continued to be introduced and tested at Rokupr, whilst all stations raised and distributed planting material of the best available varieties of swamp rice, sweet potato, mosaic-resisting cassava, yams, banana and pineapple.

V. The improvement of livestock.

Cattle.—Teko livestock experimental farm made a good recovery from the severe setback it received in 1945 following an outbreak of bovine pleuropneumonia. Work was continued in the study of Ndama cattle. Feeding trials and selection by milk yields continued. A series of experiments were started to observe the effect of climate upon cattle grazing whilst grazing trials were started with various grasses. During the year, surveys and investigations were made in the neighbourhood of Kabala, in the heart of the northern cattle country, and a suitable site for an animal husbandry station was selected at Musaiala. This new stock farm will replace Teko which was too small and did not provide conditions typical of the main cattle-rearing areas.

At Njala, more typical of southern conditions, grazing trials and milk recording continued whilst the stall-feeding *versus* free-grazing test, started in 1945, was concluded. This last experiment indicated that under southern rain-

fall conditions, with ample fresh grass available all the year except for a short period in the dry season, stall-feeding is not an economical proposition. The health of the Njala herd, all Ndama type, continued good and has now been maintained over several years. The same remark applies to the small working herds kept at Rokupr, Kenema, Makeni and Newton. Apart from the possibility of epidemic diseases there appears no inherent reason why local cattle, with good management, should not be kept in flourishing condition throughout the country.

Butter Production.—Small scale production of butter and cream continued at Teko.

Pigs.—The elimination of all native blood from the Njala and Newton herds, started in 1945, was completed during 1946. The stock at Newton now consists of large whites imported from Nigeria in 1946, and a very promising strain (large white-middle white) bred from pigs purchased from the war-time R.A.F. piggeries. At Njala the herd remained Berkshire. At both places the pigs have thrived and first sales of breeding stock to local pig-keepers and animals for slaughter at the Freetown Cold Storage Company, have been made. The work is developing largely at Newton where there is keen demand from Colony farmers for good foundation stock. Newton sold 40 pigs for breeding or slaughter during the year in addition to supplying basic breeding stock to other departmental farms. The main difficulty at both Newton and Njala was maintaining an adequate supply of the right kind of foodstuffs. In a rice-producing country the naturally cheapest and most abundant food ought to be rice meal. The native method of rice hulling, however, precludes the separation of fine edible meal from the silica-containing husks and, with the exception of the Government rice mill, there is no reliable safe source of good meal. Pig production on a large scale appears dependent upon the solution of this problem. Laboratory analyses of various hulling fractions have been made and the problem has been submitted to Messrs. Grant, rice mill makers. At present, however, it seems that until more rice mills are established the shortage of meal will remain. Protein was another difficult food to obtain in quantity. Dried blood from Freetown and groundnuts helped to supply protein requirements but there, again, it might not be possible to obtain these in sufficient quantities if pig keeping develops on a large scale. Fortunately, supplies of sweet potatoes and cassava are readily available at most times of the year. Although all foodstuffs are relatively expensive it was possible at Newton, with correct methods of feeding and management, to rear pigs in six months to a marketable size i.e. 150 lb. at a cost of 6d. per lb. liveweight. With the selling price in the region of 1s. to 1s. 3d. per lb., liveweight, pig-keeping under these conditions proved profitable.

Sheep.—An attempt is being made at Teko by breeding from a short-legged, deeper bodied ram to improve the conformation of the local sheep.

Small Livestock.—Rabbits and Guinea pigs introduced at Newton in 1945 are doing quite well there and at Njala, and there is an increasing demand from smallholders and others wishing to obtain foundation stock.

Poultry.—Newton and Njala continued as the main R.I.R. producing and distributing centres, distributing 1,547 eggs for hatching and 88 adult chickens for breeding purposes during the year. As the stock had become very inbred due to the lack of new importations during the war, new stock in the form of twelve pullets and two cocks was obtained for Njala from Rhode Island, U.S.A. These did well and breeding stock is now being built up from their progeny whilst all old stock is being disposed of. The attempt to obtain eggs from England by air was not successful. Of the 30 eggs despatched only six hatched out and of these only one chick survived.

Veterinary Department.—The Veterinary Officer at Teko maintained a close liaison with all departmental livestock work and gave invaluable assistance especially in measures for the prevention and treatment of disease.

**B. THE CULTIVATION OF MONEY CROPS AND THE EXPLOITATION
OF WILD TREES FOR EXPORT PURPOSES.**

1946 was the first full-scale post-war buying year for export crops, although shipping conditions were still not normal. Prices began to assume a more normal appearance after war-time deflation and although in some cases they were still not sufficiently attractive to the producer there were signs that once these prices adjusted themselves to the present high cost of imported consumer goods, and consequent high living costs, increased exports could be expected. In some cases post-war export prices still compared unfavourably with pre-war prices. In other cases unless there was a very marked increase producers were not impressed.

The following table of exports gives figures comparing the pre-war period 1920-1938, the war years 1939-1945 and the post-war year 1946.

<i>Products</i>			<i>Average</i> 1920-1938	<i>Average</i> 1939-1945	1946
<i>Palm Kernels:</i>					
Quantity	..	..	69,342	46,483	46,773
Value	..	..	£596,793	£381,081	£688,840
Price	..	..	£28-£5	£12-£4	£15
<i>Palm Oil:</i>					
Quantity	..	..	2,052	426	107
Value	..	..	30,122	£5,270	£4,449
Price	..	..	£60-£8	£54-£11	£41 10 0
<i>Piassava:</i>					
Quantity	..	..	3,309	2,338	4,118
Value	..	..	£33,350	£55,655	£236,352
Price	..	..	£23-£8	£40-£10	£57
<i>Ginger:</i>					
Quantity	..	..	1,858	1,640	982
Value	..	..	£45,145	£53,533	51,819
Price	..	..	£54-£10	£54-£17	£53
<i>Coffee:</i>					
Quantity	..	..	10	365	132
Value	..	..	£294	£3,319	£7,305
Price	..	..	£101-£8	£129-17	£55
<i>Cocoa:</i>					
Quantity	..	..	171	477	572
Value	..	..	£3,321	£8,741	£11,653
Price	..	..	£38-£12	£22-£12	£20
<i>Kola:</i>					
Quantity	..	..	1,896	997	1,307
Value	..	..	£56,513	£34,922	£105,470
Price	..	..	£236-£13	£27-£41	£81
<i>Benniseed:</i>					
Quantity	..	..	191	197	127
Value	..	..	£1,985	£1,993	£1,999
Price	..	..	£20-£8	£11-£9	£16
<i>Groundnuts:</i>					
Quantity	..	..	12	—	—
Value	..	..	£126	—	—
Price	..	..	£47 10 Od. - £1	—	—
Total Tonnage, all Exports			78,841	52,603	54,118
Total value, all exports			£768,649	£544,514	£1,107,887

Note :—1. Quantities are quoted in tons.

2. Price figures for 1920-38, 1939-45, are the maximum and minimum prices per ton during these periods. For 1946 the price figure is the average price per ton during the year.

Notable features are the increased production in cocoa, coffee and piassava and the revival of the kola trade. These can all be attributed to the marked price increases as a result of bigger demand. Ginger, despite the price being favourable, showed a pronounced decrease due largely to the trade uncertainty at planting time. The big decline in palm oil export as compared with pre-war years is chiefly due to increased consumption and higher prices within the country. The average annual total of all exports in the period 1920-1938 was 78,841 tons valued £768,649. During the war years this declined to 52,603 tons valued £544,514 i.e. a drop in volume of one-third, with prices per ton for the major products approximately the same as in the years immediately before the war. In 1946, although the total volume at 54,118 tons was only slightly above the war years the value at £1,107,887 had more than doubled itself and is more in keeping with present day values. The decline in total volume since pre-war years is almost entirely due to the lowered exports of palm kernels, the purchases of which depend a great deal upon the price factor. Once this price factor has been adjusted it should not be long before palm kernels exports return to normal.

Rice, which is not included in the above figures, is in a different category from other products in that being the staple food of the country little consideration can be given to its export until the needs of the local inhabitants have been fully met. Up to 1932 rice had to be imported regularly each year to meet these demands and from 1920-1931 the average annual excess of rice imports over exports was 1,204 tons. From 1932-1940, with the exception of one year due to a bad harvest, the position was reversed and surplus rice exports averaged 322 tons annually for these years. The one bad year, however, needed the import of 4,196 tons. During the war years abnormal services and labour requirements, with the exception of 1941 and 1944, were met from within the country, and in 1942 and 1945 there were surpluses of exports over imports of 1,111 tons and 810 tons respectively. In general, therefore, despite the dislocation due to the war and the one bad year's harvest before the war there has been a gradual rise in the curve of surplus rice exports over imports ever since 1932. During the war and immediate post-war periods, rice supplies have been strictly controlled, with production quotas, controlled prices and rationing. In 1947 controls are being lifted and there will be a return to free trading. How this will affect the export trade remains to be seen. The one overriding factor in rice production for export still remains soil conservation. Although swamp cultivation is expanding appreciably each year, the bulk of the rice crop is still produced on the uplands which are being steadily degraded. Until upland rice farming has been reduced to a level which will not endanger soil fertility, and until the resulting deficiency in upland production has been offset by increased swamp cultivation, it will not be possible to export any considerable quantity of rice. If large-scale mechanised rice farming in reclaimed swamp lands proves practicable and economic—preliminary investigations are not encouraging—then it would of course be possible to hasten the time when a regular export of rice could be expected.

C. THE ARRESTING OF THE DEGRADATION OF THE FOREST GROWTH OF SIERRA LEONE OR AT ANY RATE INCREASING THE REGENERATION PERIOD BETWEEN SUCCESSIVE BRUSHINGS OF THE SAME AREA.

It cannot be said that the widespread degradation of forest vegetation under "shifting cultivation" is being checked on the large scale essential if this problem is to be solved in a reasonable space of time and before irreparable damage has been done. The policy of encouraging increased swamp cultivation, and the establishment of chiefdom Soil Conservation Areas are giving good results; but the need for a more co-ordinated large-scale effort is obvious, and towards the end of the year the Soil Conservation Committee (Chief Commissioner, Conservator of Forests, Director of Agriculture) submitted a memorandum to Government recommending the formation of a special soil conservation team,

comprising administrative, agricultural and forest officers, to carry out a comprehensive survey and draw up a comprehensive plan for soil conservation and correct land usage.

D. THE IMPROVEMENT IN THE PREPARATION AND MARKETING OF PRODUCE.

Whilst concentration was made by instructional work in preparation amongst growers of the established export products: piassava, ginger and cocoa, efforts were made to find export markets for other produce. Thus samples of black pepper, sunn hemp for fibre, and coffee, were submitted to the Imperial Institute for examination and report. Cinnamon is also being persisted with, following the encouraging report received in 1945. At present there is a small local market for cinnamon but for the external trade the finer points in preparation are necessary and steps are being taken to improve preparation and submit more samples for report. During the year there was a commercial enquiry for dried cassava chips. Samples and information were sent to the firm and the Sierra Leone African Chamber of Commerce were put in touch with them. It must be admitted that attempts to establish an export market for new lines of produce have innumerable difficulties to contend with. Competition is keen from other tropical countries, already long established in a particular product; the quality demanded is frequently higher than can be immediately obtained in Sierra Leone and prices are very competitive. It may therefore take several years of persistent effort before obtaining the right type and quality acceptable to external markets, and even then there may still be no guarantee that a permanent market will develop. Past experience in attempting to establish products other than the regular, old-established Sierra Leone exports has been disappointing, but conditions in the post-war world have changed, and we can but hope that steady, continuous efforts may eventually lead to new products finding a good market.

During 1946 machines for the better preparation of coffee, the cracking of kernels and the preparation of fruit juices were ordered from England. A large rice mill for the Scarcies area is also being ordered and the two smaller mills at Kenema and Rokupr have continued successfully. Once these projects have been tried out by the department and can safely be recommended as economically sound the intention is to establish African enterprise in these processing industries.

With regard to the main exportable products considerable work was done in improving the quality and exploring the markets for piassava. Agricultural Instructors, augmented by Produce Examiners gave continuous, comprehensive instructions and demonstrations throughout the year amongst the Sherbro producers whilst in the latter half of the year similar work was extended to cover the Sulima area. Samples were submitted to the Imperial Institute which made trade enquiries and gave valuable advice. First hand information was also obtained by a representative of the department making visits to the Imperial Institute and a prominent United Kingdom firm of piassava dressers. The result of this work is that the quality is generally excellent, with very favourable opinions from overseas buyers, whilst every step is being taken to expand markets.

In the Moyamba-Mano area the instructional work, revived in 1945, amongst the ginger cultivators, continued to give good results and the quality is again well up to the best pre-war standards. Steady work also continued in the Kenema cocoa area in improving fermentation and drying of cocoa beans.

E. THE PRESERVATION OF THE STANDARD OF EXPORT PRODUCE BY INSPECTION

The most important accomplishment of the year was the complete revision and re-drafting of the Produce Ordinance. The new Ordinance and Rules became effective in the latter half of the year and had an immediate effect in strengthening the work of the Produce Inspection branch and in improving the quality of all the main exportable produce.

The Produce Inspection staff was increased, largely by the recruitment of African ex-Army non-commissioned officers. These men have proved themselves very suitable for this type of work. They are firm yet tactful, hard-working and adaptable. A further expansion in African staff is planned for 1947 when the appointment of a European Inspector in charge is also expected. This should enable the whole country to be covered by inspection staff. Palm kernels, piassava and ginger remain the chief products inspected, but as soon as staff permits it is intended to include cocoa and coffee.

F. CO-OPERATION WITH THE EDUCATION DEPARTMENT WHERE POSSIBLE IN THE TEACHING OF AGRICULTURE

The Njala Training College is run conjointly by the Education and Agricultural Departments for the training of Elementary School teachers and Agricultural Instructors. Twenty-two Agricultural Students were in training there during the year. These will later be drafted to the department as Instructors, supplementing the 32 past students already in the department. In addition nine Forestry students were at the College receiving a grounding in combined educational and agricultural subjects. Apart from the work of the Njala Training College, schools which have school gardens received periodical visits from Agricultural Officers and Instructors and advice and assistance were given.

G. RESEARCH

The plant pathology, entomology and chemistry sections of the department began to assume a more normal pre-war status during the year with the Plant Pathologist able to devote more time to specialist work; Mr. F. A. Squire, Entomologist, returning at the end of the year from secondment to the Cocoa Research Institute Gold Coast; and with chemical apparatus and material coming forward. The plant pathology and chemistry sections were further strengthened by the appointment of two Sierra Leone African Assistants qualified in Science in the Higher School Certificate. The appointment of a fully qualified Agricultural Chemist is expected in 1947 but pending his arrival considerable analytical work was done by Mr. J. M. Dent, Agricultural Officer, on the soil-toxicity problems of empoldered rice areas in the Scarcies and at Wellington. In the entomology section a valuable report was submitted by Mrs. Jordan, Entomologist, on the results of Citrus Moth Investigation carried out by her from December, 1942 to July, 1945. In addition various pests of rice, cocoa, coffee, mango and stored products were studied and reference collections of insects made.

In the plant pathology section a fungus disease not previously seen on cultivated rice in Sierra Leone was investigated, and diseases of tomato, bean and citrus were also studied. A large collection of fungi and flowering plants was made during the year and duplicate specimens were sent to Kew and the Imperial Mycological Institute.

H. SOIL CONSERVATION

The establishment of "Soil Conservation areas" in the Nongowa Chiefdom of Kenema District in 1945 was extended to two more Chiefdoms by the Forestry Department. So far this is the only conservation scheme of a compulsory nature. It has been well received by the farmers and there is no doubt that its application on a wider scale would have beneficial results. Preservation of forest growth in conservation areas, however, is only one aspect of a complex problem requiring a complete economic and agricultural survey of the whole country, and which might involve movements of farming population and profound changes in native traditional farming practices. The scope of any investigation and possible recommendations is so wide that, in order to co-ordinate soil conservation work, proposals were made at the end of 1946 for the formation of a soil conservation team comprising officers of the Administration and the Forestry and Agricultural Departments.

I. NUTRITION

During 1946 there was no shortage of a wide variety of farm and garden crops and it was a good season for the staple rice crop. Chinese yams, sweet potatoes, pigeon peas, cassava, groundnuts and native vegetables continue to develop as accepted articles of diet. Fruit production, especially bananas, pine-apples and citrus, is also increasing steadily although supplies are still inadequate in some parts of the Protectorate. Animal proteins for the most part continued short of optimum requirements.

J. EXTENSION WORK. ALL EXTENSION WORK AND PROPAGANDA MUST BE BASED ON INFORMATION GAINED FROM EXPERIMENT OR FROM EXPERIENCE BY AGRICULTURAL OFFICERS IN SIERRA LEONE

Whilst in 1946 full scale progress of post-war development plans was still not possible, owing to the continued shortage of personnel and the slow delivery of machinery and implements, an appreciable amount of the necessary ground-work was accomplished. Thus, the Agricultural Ordinance was completely redrafted in the light of present requirements and became law, thus strengthening the Produce Inspection Branch considerably. The research sections began to assume their normal appearance after the hiatus of the war-period. Pig and poultry breeding were completely revised, with the removal of old stock and the importation of fresh blood. The first tractor plough arrived for trials in reclaimed land in the Scarcies, whilst machinery for palm kernel cracking and fruit pulping and a large rice mill for the Scarcies were ordered. Inland swamp settlement of individual farmers on organised lines was started in the Makeni area and the clearing of mangrove swamps for rice farming in the Bonthe area gathered impetus.

The irrigation and drainage schemes, started on too ambitious and wide-spread a scale during the war years without sufficient basic data or experience, have been temporarily restricted to small-scale centralized experimental projects, of which the structural engineering work is now under the charge of the Public Works Department working in close collaboration with the Agricultural Department. Concurrently with irrigation schemes and swamp farming generally, research into soil toxicity problems is being undertaken and useful preliminary results were obtained during the year.

At the Teko livestock farm long-term experiments in cattle breeding and management were continued, and valuable data is being accumulated there, whilst surveys and plans for the new animal husbandry station at Musaia made good progress. Grassland investigations continued at Teko and Njala.

The training of Native Administration Agricultural Demonstrators, started in 1945, and the further development of native administration farms progressed steadily and well.

Information at all stations, particularly Makeni, is being accumulated as a result of experiments and experience in the maintenance of soil fertility in inland swamps. This, together with knowledge gained in swamp clearance projects, soil conservation measures in Kenema District, valley cultivation and composting in the Colony, and the eventual results of mechanized farming trials in the Scarcies will form an invaluable foundation for the work of the proposed new land utilization and soil conservation teams.

SECTION II—THE WORK OF THE AGRICULTURAL DEPARTMENT

(a) ORGANISATION AND STAFF

6. Although the staff situation remained unsatisfactory—in so far as it was not possible to fill the long-vacant posts of Chemist, Inspector of Produce and Marketing Officer—it was considerably eased by the appointment of three new Agricultural Officers, and it was possible to arrange for Agricultural Officers to give more attention to extension work and spend more time visiting farmers in

their villages. One Agricultural Officer, Mr. E. S. Garner, was invalided out of the service. The headquarters office was strengthened by the provision of an Office Assistant, the post being filled by Mr. S. A. D. Peters.

7. The Plant Pathologist, Mr. F. C. Deighton, O.B.E., acted as Director from 6th June to 10th November when both the Director and the Principal Agricultural Officer were on leave.

8. All departmental experiment stations and farms were maintained, but with a reduction in size and scope in the case of the farms at Sembehun and Kenema in order to release agricultural staff for increased extension work. Two new sub-stations were opened, at Kabala and Makali in the Northern Province. A new departure was the posting of an Agricultural Officer to Bonthe to undertake work in connection with piassava improvement and rice development.

9. The Irrigation and Drainage Branch was transferred from the control of the Agricultural Department from the beginning of 1946, and has become the Land Drainage Branch of the Public Works Department. This is proving a more satisfactory arrangement, since land drainage is primarily an engineering problem. Close collaboration will be maintained between the two departments.

(b) AGRICULTURAL STATIONS

NJALA

10. *Crops*.—Crop experimental work continued to be largely directed towards the establishment and management of upland pastures, with a view to (a) the possible recuperation of degraded upland soil by rotational cattle grazing (b) the improvement of grassland for stock feeding (c) the testing of promising indigenous and exotic grass varieties and (d) the substitution of grass for bush fallow.

11. *Upland Grasses*.—In the upland grass trials, started in 1944, results for 1946 confirmed the conclusion of the previous two years that Guinea grass (*Panicum maximum*) is superior to Elephant grass (*Pennisetum purpureum*) when grazed intensively. In addition Guinea grass was preferred by cattle, provided a greater annual yield, gave more grazing in the dry season and recovered more quickly after intensive grazing and over-grazing. A comparison of the number of cow-days grazing per acre in 1946 is as follows:—

			Elephant grass	Guinea grass
Single animal grazing	...	...	64 days	167 days
Mass grazing	...	...	96 "	320 "

12. By June there was evidence of over-grazing in all plots but whereas by August the Guinea grass had begun to recover the elephant grass showed no signs of recovery. By October the plot of mass-grazed Guinea grass was again fit for grazing although that grazed by a single animal was not so good and was not grazed again till November. The elephant grass, however, could not be grazed again during the year despite replanting the gaps caused by the stools dying out. In the case of both these grasses it was found that grazing a large number of animals at intervals, rather than a single animal most of the time, gave more feed and kept the pastures in better condition. It is also apparent that a certain amount of pasture management, in the form of occasional low cutting to remove old woody stems and to promote tillering, and replanting of stools which have died out, will be necessary if the pastures are to be kept in a high state of productivity. Several more years must elapse before final conclusive results can be expected but figures for the three years since these two grasses were first compared on the uplands are of interest. These figures (in cow-days per acre) are based on various grass experiments and calculated from all plots which received no manure other than that received during grazing.

					Elephant grass	Guinea grass
1944	...	...	...	...	151	291
1945	...	...	...	...	273	447
1946	...	...	...	...	80	243

The only case in which elephant grass appears more productive than Guinea grass is when grown in swamps for fodder. Here, in the first year of establishment, elephant grass gave three times as much fodder as Guinea grass.

13. Other upland grasses grown for observation were Rhodes grass (*Chloris Gayana*), *Pennisetum* spp, *Cenchrus ciliaris* and *Paspalum dilatatum*. The Rhodes grass, both the creeping and tufted strains, which showed promise in 1945 was a failure in 1946. It could not hold its own with the heavy growth of the common local grass *Panicum laxum* and almost died out during the dry season.

14. *Swamp Grasses*.—In addition to work with upland grasses, a start was made with the establishment and management of grasses in wetlands. The following grasses were grown:—Elephant grass, Guinea grass, *Paspalum dilatatum* from East Africa, *Cenchrus ciliaris*, *Axonopus compressus*, Rhodes grass from East Africa, and *Panicum laxum*. All except Rhodes grass established well but *Cenchrus ciliaris* failed to maintain its growth in the dry season. Elephant grass and *Panicum laxum* are the most promising.

15. *New grasses*.—Newly introduced grasses being multiplied for trial are *Andropogon gayanus* and *Pennisetum hordeoides* from the Gambia, *Brachiaria mutica* (Para grass) from Trinidad, and two untried *Pennisetum* species (perennials) from other parts of Sierra Leone. All show promise.

16. *Silage*.—Observations on the making of pit silage show that Guinea grass, maize and *Pueraria phaseoloides*, either singly or mixed, give good results. *Pueraria* is now the standard fodder and silage legume. In the maize plots grown for silage the effect of a dressing of artificial fertilizers was appreciable. The whole plot of one acre received compost at the rate of 35 tons per acre. Half the plot then received a dressing of complete artificials at the rate of 5 cwt per acre. Yields of cut greenstuff were 7,128 lb. per acre from plots treated with compost plus artificials as against 3,882 lb. per acre from plots receiving compost only.

17. *Annual crops*. (a) *Yams*.—Eight varieties of yams were grown on ridged upland soil, heavily manured with compost. Yields, which were considerably higher than in 1945, were as follows:—

Variety						Yield per Acre
No.						Tons
No. 32	Nigerian	...	...	...	...	8.32
" 33	"	...	...	...	...	7.76
" 105	"	...	...	...	...	3.00
" 152	"	...	...	...	...	4.41
Jaffna King	...	...	...	...	...	6.30
Chinese	...	...	...	...	...	4.00
Yellow	...	...	...	...	...	2.63
Port Loko White (local)	...	...	...	...	...	1.01

18. The two Nigerian selections 32 and 33 gave the highest yields but their palatability was not so good. Jaffna King showed the least resistance to disease, but had good palatability and, until the introduction of the two Nigerian varieties, was the best yielder.

19. (b) *Ginger*.—Observation trials on Jamaican, Dominican and Canton ginger continued, with inconclusive results. Line selection of local grey and yellow varieties was started in 1946. Selection was by weight and size of hands. Fifty families of each were planted, each family consisting of six pieces obtained by breaking the selected hands. By this method, which will be continued for several years, it is hoped to isolate improved strains.

20. (c) *Upland Rice Varieties*.—Twenty-eight local and imported rice varieties were grown on the uplands for observation and selection. Yield, length and strength of straw, duration, disease-resistance and palatability are the selection criteria. So far the local variety Pa Werike and three imported Peruvian strains appear to be the most promising.

21. (d) *Other Annual Crops*.—Russian sunflower made good growth, but seeds failed to fill properly. Of the Soya bean varieties, Trinidad was a complete failure but Malayan and Miscellaneous 28 grew well although yields in no way compare with groundnuts. Various other introductions were grown for observation. These included various legumes, Gold Coast cassava and raspberry. Nigerian beniseed and onions, various sweet potatoes, East African finger millet, *Indigofera endacophylla*, Black gram, Ceylon cowpeas and loofah, Jamaican hybrid cigar tobacco, Bonavist beans and *Coix lachryma-jobi* from British Guiana. New grain crops which grew well in the nursery and are to be multiplied for field trials were *Panicum miliaceum*, *Panicum miliare* and *Setaria italica*. Sugar cane, grown with indifferent success on ridges in previous years, has made vigorous growth when grown more closely planted on broad-based beds with a dressing of artificials.

22. *Permanent Crops*.—Yields from individual trees continued to be recorded from the established plantations of citrus, coffee and oil-palm (Deli, Angola and Nigerian stock). With Marsh grapefruit, a manurial trial was laid down to compare the effect on yield of applications of complete fertiliser (N.P.K.); phosphate alone; potash alone. There was considerable variation in the yields of individual trees within the same treatments; and although analysis of the results showed no statistical significance, it appeared that the application of phosphate alone or of potash alone increased the yields over the control to a greater extent than the complete fertiliser. It should be noted that all trees had been heavily mulched with vegetable matter before the artificials were applied and it is possible that the mulch supplied sufficient nitrogen to make the application of additional nitrogen unnecessary. All fruit from individual trees was graded for size and the best trees are to be used for budding clonal selections, the criteria being yield, quality and uniformity in size of fruit. The pure-line multiplication plot of Angola oil-palms was rogued for type of fruit. This was their second year of bearing and all seeds from trees of the right type were planted. Multiplication and distribution of citrus and various economic and ornamental plants was continued on a large scale.

23. *Cattle*.—The herd of Ndama cattle kept very good health throughout the year and there was little trouble from trypanosomiasis or other diseases. An experiment started towards the end of 1945 to compare stall-fed heifers with free-range heifers was concluded. At the height of the dry season the stall-fed animals gained weight whereas those on free range lost weight; but when the grass flush became available the animals on free range quickly made up their losses. The final weight increases over the period of the experiment—December to June—were similar in each case; and it appears that stall-feeding, except possibly for a short period at the height of the dry season, is not economic if good grazing is available. Milk recording was continued and the following figures obtained:—

Cow Number	Lactation Period	Milk in lb.	
		Total Yield	Maximum Daily Yield
1	258	878	51 ⁹ / ₁₆
11	225	535	7 ⁶ / ₁₆
30	248	1,000	7 ¹ / ₁₆
33	519	1,510	13 ¹ / ₄
34	248	574	7
38	236	295	5
39	235	714	4 ¹ / ₁₆
41	194	770	5 ⁴ / ₁₆
43	250	780	7 ³ / ₂

Apart from the culling of a few unthrifty animals the herd consists of unselected cows. Several of these—Nos. 30 and 33 in particular—are, however, good by local standards. Yields have been considerably increased by good feeding and management but further improvement cannot be expected without selective breeding. The long lactation of cow No. 33 was due to this cow being in a feeding experiment which prevented her from being served earlier.

24. *Sheep*.—Work with local sheep was discontinued during the year. Various systems of feeding and management had been tried over several years but the flock remained unthrifty and completely uneconomic.

25. *Pigs*.—The policy laid down in 1945 of keeping only pure-bred English stock promises to give improved results. As far as possible the native strain has been eliminated, and the stock is now nearly pure Berkshire. It is proposed to introduce Large Whites from Newton in 1947 to compare their performance with Berkshires. The health of the pigs was good, they bred well and the high selling price of pigs made concentrated feeding profitable. The main difficulty was in obtaining sufficient and varied foodstuffs. Protein was the chief deficiency. Dried blood meal, available in small quantities, gave good results and young pigs averaged 100 lb. live weight in six months. Under the circumstances this is satisfactory but further improvement is hoped for.

26. *Poultry*.—The R.I.R. stock at Njala, with no fresh blood during the war-years, had become inbred and deteriorated. To remedy this, new stock was obtained during the year. Two methods of importing were tried, eggs by air from the United Kingdom and young birds by sea from Rhode Island, U.S.A. The egg importation was a failure. Out of 30 eggs only six hatched and only one chick survived. The two cocks and twelve pullets from Rhode Island arrived in excellent condition, egg production started immediately and has continued since at a good rate. All old stock is now being disposed of and the American strain is being multiplied as foundation breeding stock.

27. *Rabbits*.—Rabbits were started at Njala in 1946 with a buck and two does from Newton, the strain being Belgian hare and St. Helena. By the end of the year the stock had multiplied to 22 adults and 25 young. The rabbits have done well, were of little trouble and no disease occurred. Distribution will start in 1947.

28. *Extension work—Organization*.—During the year the Njala Circle was reorganised to include part of the former Sembahun Circle, Sembahun becoming a sub-station under Njala. Njala Circle, re-named South-western Circle, now includes the whole of Bo, Pujehun and Moyamba Districts.

29. *Wet Season Swamp Farming*.—The policy of encouraging individual farmers, instead of communities, to establish rice farms in inland swamps is giving good results. A rough census taken during the year of such farms gave the following approximate figures for the Bo and Pujehun Districts: farmers 4,000; acres cultivated, 5,000.

30. *Mangrove-clearing Loan Scheme*.—No new rice farmers were given loans in Moyamba District during the year, the policy being to consolidate existing clearances and to collect more repayments before embarking upon further extensions. This appears to have had a good effect, farmers are beginning to realize the value of these farms and many are clearing and expanding steadily on their own initiative. The number of farmers who have received assistance in Moyamba District since the scheme first began in 1939 now totals 550.

31. *Dry Season Swamp Farming*.—Market gardening and dry season cultivation of a wide range of crops is now well established and increasing year by year.

32. *Ginger*.—Bo-Moyamba area is the main ginger producing part of Sierra Leone. Work there has been a continuation of the drive for improved quality, started in 1945. The result is that the standard of ginger has improved considerably and no further adverse trade reports have been received.

33. *Cocoa*.—With the marked increase in cocoa prices farmers in the Pujehun cocoa districts have shown renewed interest. Farmers received advice and directions in cleaning and extending their plantations and in fermenting and drying the crop for market.

34. *Piassava*.—During the year it was found necessary to extend the piassava inspection scheme, started in the Sherbro Area in 1945, to the large producing areas in Pujehun District. Sulima piassava, which prior to the war formed some two-thirds of the total export, is mainly produced in this area. Through lack of inspection and instruction the quality had deteriorated during the war. The exceptionally high prices of 1945/46 and the large demand caused hurried retting, bad cleaning and the inclusion of a great deal of immature fibres. The resumption of instruction to producers and the tightening up of produce inspection had, by the end of 1946, led to a satisfactory improvement in quality.

35. *Sub-stations*.—Sembehun, formerly a separate station, became a sub-station under the Agricultural Officer, Njala. Work here is now limited to the multiplication of swamp rice, yams, coconuts and oil-palms for distribution. The yam varieties grown confirmed the result at Njala, the Nigerian selections 32 and 33 giving the highest yields.

ROKUPR

36. *Crops*.—Rice experimental work continued to be the main function of this station. Within the empoldered area the effects of soil toxicity are still very marked and experiments inside the polder are largely devoted to investigations to discover the cause of toxicity and how to counteract it. General rice experiments, in addition to maintenance, selection and multiplication of rice varieties, are continuing both on the less toxic plots within the polder and on unaffected plots outside.

37. *Soil Toxins*.—In 1945, chemical analysis of water and soil from the empoldered area indicated that the failure of the rice might be correlated with high acidity and the presence of ferrous iron and sulphate. In 1946 preliminary observation tests were done with a view to correcting this condition and to provide data for comprehensive experiments. In one test, a block affected slightly by toxins was divided into two. One-half was allowed to dry out during the dry season while the other half was flood-fallowed. The yield on the first half was worse, while that on the second half was better than in the previous year. In another test, lime—by neutralizing the acidity—gave promising results on a badly affected plot, but in the absence of a cheap source of lime in quantity, liming is not a practicable proposition. It was also noticed that the toxic effect was most marked on soil near the river bank which formerly grew mangrove. Accordingly an observation trial was started on this particular area which has been divided into four portions; one fully tidal without bunds; one bunded and under full water control i.e. dry in the dry season, wet with rain water and controlled irrigation in the rains; one, bunded, tidal during the rains and dry during the dry season; and one bunded, tidal during the dry season but under controlled irrigation during the rains. In this first year the tidal-washed areas have given better yields than those under water control.

38. *Rice Varieties*.—As in previous years a wide selection of introduced and local varieties was maintained for observation. Some 72 varieties were grown whilst several more local varieties remain to be classified. Selection work continued. Mass selections made in 1945 were planted separately for further selection whilst single-panicle selections were made in the case of six established varieties; Toma, India-pa-lil, Ngasein, Indo-China, Kavunginpoothala and D.C. 39. A comparative yield trial with six mid-season varieties showed no significant differences.

39. *Purity of Seed*.—Constant rogueing has restored the purity of most varieties to their pre-war high level.

40. *Economics of Rice Harvesting and Threshing*.—Costings of the 1946 harvest confirmed the 1945 results that harvesting and flailing in the field by the native method is cheapest. Mechanical threshing, however, is to be tried out. It was interesting to note that the heavier the crop, providing it was not layered, the more economical were the harvesting and threshing.

41. *Other Crops*.—Various types of cassava were grown to observe the degrees of their susceptibility to mosaic disease. Various legumes, including sunn hemp, "yawa" cowpeas, green gram, Jerusalem pea and *Pueraria* were grown under various conditions. Nurseries of sour orange for budding, and of Angola oil-palm for distribution to local farmers were extended.

42. *Livestock*.—As in previous years the health of the small herd of Ndama cattle at Rokupr has been good.

43. *Extension Work*.—The sub-station at Port Loko and the Native Administration farms at Marampa and Kaffu Bullom continued multiplying and distributing planting material which provided a valuable nucleus of good improved stock amongst native farmers. This material included citrus, oil-palms, bananas, yams, cassava and rice. Under departmental and Native Administration Schemes, 500 bushels, only, of pure rice seed were distributed. This guarantees purity and continues the policy of aiming for the highest quality rather than quantity. 1,050 bushels of seed rice of improved varieties were sent to the Department of Agriculture, Gambia.

44. *Oil-Palms*.—Small plantations of the high-yielding Angola oil-palm were established at Rokupr, Mahera and Marampa whilst all available seed of both this type and Deli is being collected to start nurseries in 1947, the object being to substitute native-owned plantations of improved oil-palms for the present bush collection from low-yielding wild local palms.

45. *Irrigation and Drainage Schemes*.—As a result of the failures in 1944 and 1945 of the large scheme, started in the Scarcies during the war, the whole project was reviewed and replanned on the advice of the visiting engineering consultant. The policy now is to get full data and experience by test plots and experimental drainage work before embarking upon large-scale operations. Early in the year, the Irrigation and Drainage Branch was transferred from the Agricultural Department and became the Land Drainage Branch of the Public Works Department. Close co-operation was maintained between the two departments, and satisfactory progress was achieved in spite of the serious shortage of staff in the Land Drainage Branch.

46. *Mechanical Cultivation*.—A wheeled tractor, plough and disc harrow arrived late in the year and although they were demonstrated successfully on upland soil it remains to be seen how effective they are in reclaimed swamp areas. The economics and possibilities of mechanical cultivation in tidal swamp rice areas will be studied, using various types of machinery. If satisfactory results are obtained it may be possible to develop such cultivation on a large scale. At present work is handicapped by the continued delay in delivery of essential machinery, including a tractor of the "caterpillar" type.

47. *Rice Mills*.—The small "Planters" mill at Rokupr had its most successful year, milling over 6,000 bushels of paddy. Milling charges, however, at 6d. per bushel were uneconomic. Double this figure would ensure a reasonable profit and would still be considerably less expensive than by present hand methods. It remains to be seen whether the Scarcies rice farmer is prepared to pay this rate. Interesting trials are being made by the makers of the "Planters" mill to see if the valuable bran and meal by-products can be separated from the usual rough mixture of husk and bran turned out during milling. Cheap concentrates, especially for pigs, are a problem in Sierra Leone and any means whereby supplies of rice bran and meal could be increased would be welcomed. Plans and estimates were submitted for a large $1\frac{1}{2}$ tons per hour mill to be erected at Mambolo in the heart of the Scarcies rice growing area. The installation of this mill is part of the development programme.

48. *Inland Swamp Cultivation*.—In addition to work in tidal swamps in the Scarcies, propaganda and assistance were given to encourage the wet season cultivation of rice and the dry season cultivation of market garden crops in inland swamps. Results were especially noticeable in Kaffu Bullom and at Marampa, where the iron mines personnel have benefited considerably from a wider variety of food.

BONTHE

49. At the end of 1945, as a result of the post-war revival in the Sherbro piassava trade and the more rapid progress of the Mangrove clearing scheme in the direction of Bonthe it was found advisable to transfer the Agricultural Officer from Sembahun to Bonthe. Sembahun remains as a sub-station. Bonthe is more centrally situated and is the headquarters both of the Administration and produce firms. Bonthe is also more convenient as a centre from which the promising Bum-Kittam riverain grassland areas can be prospected and developed.

50. *Mangrove Clearing Loan Scheme.* Mangrove clearing and the establishment of rice growing in the cleared areas progressed satisfactorily in Bonthe District. Loans were advanced to 135 new farmers who cleared an estimated 400 acres of mangroves. The total of farmers now established in the Sherbro mangrove areas since the scheme first began in 1939 is 537. The demand for new loans is increasing but to ensure adequate supervision it is not proposed to establish more than a further 200 in 1947. 120 bushels of improved seed rice were distributed to farmers.

51. *Piassava.* The scheme started at the end of 1945 for improving the quality of Sherbro piassava worked well and, by the end of 1946, only first grade prime Sherbro was being exported from Bonthe. Reports from overseas buyers show that the quality of many shipments is now better than pre-war. Instructional work amongst piassava producers resulted in better retting and cleaning. This was supported by strict produce inspection at buying points. A certain amount of sub-standard material, which had accumulated before the scheme started, had been removed by the end of the year, either by recleaning or destruction. New, stricter produce inspection legislation made it possible, where essential, to prosecute buyers who persisted in trading in sub-standard material. The Bonthe area was used as a training ground for instructors and produce examiners before drafting them to the Sulima piassava areas. During 1946 shipments of piassava from Bonthe totalled 1,606 tons with prices ranging from £50 to £78 per ton. These figures are records and compare with the pre-war averages, 1930-38, of 866 tons *per annum* at £15-£16 per ton. The abnormally high price of 1946, however, was not without its disadvantages and the tendency of certain traders and producers to "cash-in" on the high price at the expense of quality needed firm handling.

MAKENI

52. The main farm and sub-stations continued as demonstrations of improved methods of utilizing inland swamps and the surrounding uplands. Their other functions include the introduction and trial of new varieties of crops and the multiplication and distribution of proved varieties. They also serve as a training ground for junior departmental and Native Administration Agricultural staff.

53. *Crops—Swamp Rice.*—Ten varieties were tried including the popular established Sughandi and Lead varieties, together with new British Guiana varieties. Lead and Sughandi both suffered from "blast." Of the new British Guiana varieties, D. 99 in fairly deep water gave the highest yield (59 bushels per acre) of any variety on the farm. Except for the local Pa-werike it is the shortest duration variety so far tried and should prove popular amongst local farmers.

54. *Other Crops.*—Seventeen varieties of sweet potatoes and 14 varieties of cassava were grown for observation and selection. Amongst new legumes under trial, "Yawa" cowpea and Green Gram were the most satisfactory. Smooth Cayenne pineapple continued to do well and is the best variety for the Makeni area. Four varieties of banana were grown in the swamp on the French Guinea system, whilst parent trees of coconut, avocado pear, cashew, kola, coffee, Angola oil-palm and citrus were maintained to provide nursery material for eventual distribution. Coconuts are in considerable demand for planting in the Makeni area. Accordingly, different treatments to nuts were tried to improve

their germination. Soaking in water, smoking, and cutting tops and bottoms were tried singly and in combination. The only facts which have emerged so far are that cutting in any form retards germination and that soaking appears to have a good effect. Planting in sand beds has reduced termite damage.

55. *Swamp Fertility Maintenance, Observation Test.*—This test, laid down in 1945, to observe the effects of various dry season treatments upon the ensuing wet season rice crop was continued. Yield figures for this first cropping season were recorded but several years' figures will be necessary before any conclusions can be drawn.

56. *Farm Economics.*—The first completed year's costings of selected swamp plots at Makeni farm show that paid labour, properly used, can give a good return. With 1946 labour rates, exclusive of supervision, and with 1946 average market prices the profit per acre on dry season sweet potatoes was £3 whilst the wet season rice crop which followed gave a profit of over £4 per acre. Although these figures probably do not bear much relation to those obtainable under purely native farming practice they do give some indication of the potentialities of swamp farming on an intensive system.

57. *Livestock.*—The cattle, kept for carting and to provide manure, maintained good health. The selection of native "Kebu" poultry continued whilst ducks have done satisfactorily.

58. *Extension Work.*—As in previous years the basic principles underlying all extension work in Makeni area have been propaganda, demonstration and assistance to encourage upland farmers to adopt swamp farming, thus decreasing the over-farming of uplands. Results of this continuous policy over a number of years are becoming marked, but much still remains to be done.

59. Three departmental sub-stations, Batkanu, Kabala and Makali are now established as model swamp farms demonstrating intensive dry and wet season production. A wide selection of the best varieties of crops, including rice, yams, coconut, Angola oil-palm, cassava, citrus, bananas and vegetables are grown for demonstration and to provide planting material for distribution. Tobacco was grown successfully at Kabala, a lively interest being shown in this crop by local producers. In addition, nine Native Administration seed farms have continued as going concerns producing planting material for sale to farmers. These farms largely concentrate upon production of good type seed rice, yams and sweet potatoes. In 1946 they produced 493 bushels of rice, 4,428 lb. sweet potatoes and 3,658 lb. yams. Improvements are constantly being made and, with contouring and bunding, the surrounding slopes are being laid down to permanent crops, including fruit trees and oil-palms. It has taken several years of steady work, against periodic setbacks, to convince local farmers that these farms are their own institutions and not just government showpieces; a wider appreciation of these farms by the people themselves is now becoming evident.

60. In addition to the seed rice and yams distributed from Native Administration farms, 1,560 bushels of rice and 5,097 lb. seed yams were distributed through the departmental revolving seed schemes.

61. The scheme, outlined in the 1945 Annual Report, for advancing money to assist the organized clearance and settlement of inland swamps, had a successful first year. £400 was voted from the Protectorate Mining Benefits Fund to cover the cost of clearing two swamps at Kamakwie and Makali. In all, 55 acres were cleared and successfully cultivated in one-acre lots rented by individual farmers. In relation to the total area of available inland swamps this represents a small beginning but it is a sound, well-planned scheme, and the interest of the farmers has been aroused and requests have been made to extend the scheme to other chiefdoms.

62. *Ploughing.*—Ploughing was first started in different parts of the Northern Province in 1928/29, as a result of the introduction of ploughs by the department.

Some 20 farmers were ploughing by 1929. For various reasons, seemingly inseparable from plough introduction in West Africa, there remained only eight men ploughing in 1937. These survivors, with one exception at Kabala, were all concentrated in the Mabole valley in Biriwa Chiefdom just north of Makeni. They were also all peasant farmers and Mandingo cattle-owners familiar with cattle. During the war, through lack of ploughs and spare parts and inadequate staff, no particular attention could be paid to these men. In spite of this they have persisted in their efforts, and some have purchased ploughs from French territory. By 1946 some 30 ploughs were in existence of which nineteen were actually in use, and the area ploughed was estimated at 170 acres of upland and 100 acres of swamps. That these Mandingo peasant farmers have obtained this result, despite many difficulties and little attention over a number of years, augurs well for the future provided concentration is made amongst Mandingo farmers who have a natural instinct for handling cattle. Every effort is being made to obtain more ploughs and more men will be started when they become available. The danger of causing serious soil erosion and degradation by careless ploughing on sloping land is fully appreciated, and every effort will be made to restrict plough-cultivation to the swamps and flat valley lands and to induce farmers to make the optimum use of cattle manure for maintaining soil fertility.

KENEMA

63. *Crops*.—During 1946 this inland swamp farm, which had tended to expand towards extensive farming at the expense of good husbandry, was made smaller and farmed on a more intensive small-holding basis. The improvement, though not yet complete, has been marked and is a further demonstration that intensive treatment of these swamps and the surrounding slopes is the only practicable method likely to produce optimum economic results. Experience at this farm has also shewn that any interference with the natural water conditions, in attempts to improve drainage, must be done with caution. Under the present treatment the fertility of the swamp is improving and a maximum of 33 bushels per acre of wet season rice was obtained during the year. Good crops of sweet potatoes and legumes were grown to demonstrate the dry season use of swamps whilst Canary bananas were established and grew successfully at the edges of the swamp, and European and native vegetables under intensive, market garden conditions grew well and produced a continuous succession of vegetables.

64. *Livestock*.—The replacement of the herd of unthrifty Berkshire-native cross-bred pigs by pure-bred Large Whites has caused an immediate improvement in pig-rearing at Kenema farm. The small herd of cattle maintained at this farm for manurial and grazing purposes showed no serious ill-health. It is intended to train men at Teko as ploughmen and to start animal ploughing at Kenema. The difficulty in this area appears to be that the people are not cattle-minded and it may take many years of patient effort before this obstacle is overcome.

65. *Extension Work*.—As in previous years the main objective of all extension work in this area was to encourage development of the inland swamps. As a result of steady propaganda, demonstration, and distribution of planting material over a number of years it is encouraging to find a good number of well-established swamp farms in all parts of Kenema District.

66. *Soil Conservation*.—The Soil Conservation Scheme initiated by the Forestry Department in Nongowa Chiefdom in 1945 has been extended to Lei and Toli Chiefdoms. These Chiefdoms, all affected by over-farmed uplands and hillsides, were declared "Soil Conservation Areas" by the tribal authorities and farming was prohibited on hills within these areas. The scheme promises well. As this scheme extends the natural corollaries should be increased swamp farming, increased forest growth on hillsides and the greater use of the degraded uplands for tree crops. In this way a better balanced utilization of land and better maintenance of soil fertility should evolve.

67. The Native Administrations throughout the district by demonstration farms, seed production and distribution, loans to assist farmers in establishing swamp farms and by provision for trained demonstrators are taking an increasingly active interest in the work of the department. Thus nineteen Native Administrations voted funds for agricultural work. Of these, six ran demonstration farms, five cultivated swamps for rice seed production, and eight by purchase or exchange organized their own supplies of seed of many kinds. Thirteen of these Native Administrations now have their own demonstrators, trained in simple agricultural work, whilst four have instituted schemes for financial aid to assist swamp clearance.

68. *Seed Distribution*.—Under departmental and Native Administration Schemes, 1,966 bushels of seed rice, 1,570 lb. seed yams, 20,000 oil-palm seeds, 200 oil-palm seedlings, 15 bushels shallots and 50 bags of ginger were distributed for planting during the year.

69. *Cocoa*.—With the revival in cocoa prices during 1946 it was possible to interest cocoa farmers in cleaning their plantations and preparing a better quality product. Several Native Administrations provided men for training as demonstrators and these, together with departmental instructors, toured the cocoa areas with beneficial results. Bad storage and storing too long, in middlemen's stores, can, however, undo all the instructional work amongst producers and this fault is receiving attention. Monkey damage is still very serious, and in the continued absence of sufficient guns it is very difficult to take effective action.

NEWTON

70. This station, the nearest to Freetown, is largely concerned with measures for the rehabilitation of over-farmed degraded uplands in the Colony area, and in encouraging pig-keeping, fruit and vegetable growing, and swamp rice cultivation. Trials to evolve the best methods of checking erosion and recuperating degraded upland soil, continued. Contour bunding and ridging, grass fallowing and the use of composts and manure with intensive cropping are giving encouraging results.

71. *Grasses*.—As at Njala, Guinea grass is, so far, proving to be the best upland pasture and fodder grass. *Andropogon gabonensis* has also done well under dry conditions. In swamps, elephant grass (*Pennisetum purpureum*) is the most successful and has the advantage of being preferred by pigs.

72. *Upland Permanent Crops*.—With the uplands in the Colony area becoming rapidly degraded and less capable of producing good yields of annual crops the need for leaving the uplands to permanent crops and limiting annual crops to the swamp, valley and garden lands is of first importance. Permanent crops under trial include citrus, oil-palm, mango, avocado pear, cinnamon and cashew. All grow satisfactorily, particularly with dressings of artificials. The question of finding markets for citrus, cinnamon and cashew nuts is to be investigated by the Market Officer.

73. *Valley Swamp Crops*.—Excellent crops of rice (D. 99 and D. 14) were grown on irrigated terraces and were followed by vegetables. A similar system is used for pineapples and pawpaw cultivation.

74. *Reclamation of Saline Swamps*.—Chemical investigation in 1946 by Mr. Dent, Agricultural Officer, indicated that the toxicity which appeared as the result of empoldering saline swamps at Wellington and Maswari is correlated with the areas which previously carried mangrove. However, considerably more investigation is required before the problem can be fully understood. Satisfactory yields of rice were obtained from the non-toxic areas within the polders.

75. *Livestock—Pigs*.—The reorganization of Newton Piggeries, started in 1945, has given most encouraging results. The stock is now confined to Large Whites obtained from the Nigerian Department of Agriculture and a strain

derived from a Middle and Large White cross. It was first thought that in order to safeguard them from tsetse flies the newly imported Nigerian animals should be kept in fly-proof styes. The pigs did not thrive under these conditions and compared unfavourably with those in open pens. They are now all in open pens and thriving well, with no sign of trypanosomiasis. Some 40 animals were sold for breeding or slaughter, and Newton has now become the centre for distribution of basic stock to other agricultural stations as well as to smallholders in the Colony area where pig-keeping is increasing steadily. Feeding was a difficulty, but with the help of groundnuts, rice meal, dried blood, *Pueraria* and other green-stuff the average live weight at six months was 150 lb. Inclusive costs of producing this figure was approximately 6d. per lb giving a good commercial profit when the pigs were sold.

76. *Rabbits*.—These continued successfully during the year, and provided foundation stock for other stations and for the Gambia. Breeding stock was also distributed to interested Africans of the Colony area.

77. *Cattle*.—An experiment to compare hand-rearing of calves with natural rearing by cows showed clearly that hand-rearing was not a success. This is in contrast with results at Teko.

78. *Beekeeping*.—At the beginning of 1946 two hives were started and by the end of the year there were thirteen, all doing well. One experimental hive has been placed in a mangrove swamp with a view to encouraging beekeeping in the *Avicennia* mangrove areas.

79. *Extension Work*.—Assistance to Colony market-gardeners, fruit-growers, and pig-keepers, and rice seed distribution in the Colony and Koya Chiefdom continued as the main lines of extension work.

TEKO STOCK FARM

80. This livestock experimental station has made a satisfactory recovery from the severe setback it received in 1945 when there was a serious outbreak of Contagious Bovine Pleuro-pneumonia, which killed many of the best cows.

81. *Cattle—Milk Records*.—The following tables show the progress obtained by selective breeding and improved management and feeding:—

Year					Total Cows milked	Average number of Cows in Milk	Total Milk production	Average per Cow per lactation
1944	..	..	..	..	26	8	10,136 lb.	390 lb.
1945	..	..	..	..	16	9	12,356 „	722 „
1946	..	..	..	..	18	8	13,955 „	1,077 „

Year					Average length of lactation	Average Birth Weight of Calves
1944	..	..	..	..	152 days	30.3 lb.
1945	..	..	..	..	203 „	34.1 „
1946	..	..	..	..	237 „	35.0 „

The percentage of butterfat throughout this Ndama herd averages approximately 7 per cent, and the comparatively small quantitative yields should be considered in yields of butterfat to give a better and more reliable comparison with other types of cattle. During 1946 the small scale butter and cream production, started in 1945, was continued, and 239 lb. butter and 62 pints of cream were produced for local consumption.

82. *Fertility*.—The fertility of the herd is also quite good. The average service period (interval between calving and the next fertile service) is 113 days, i.e. the cows calve approximately every thirteen months, and the average service

record (number of services per conception) is 1.1. The reproductive organs of the cows are examined periodically for pregnancy and infertility, and treated if necessary. This is partly responsible for the low service period and service record.

83. *Feeding Trials.*—To-date 52 different rations have been tried out with milking cows and calves. The best rations, using readily available foodstuffs are :—

No. 22 :				
Maize meal	...	...	...	10 parts
Groundnut meal	...	...	...	10 "
Blood meal	...	...	...	4 "
Bone meal	...	...	...	0 $\frac{1}{4}$ "
Salt	...	...	...	0 $\frac{3}{4}$ "
No. 52 :				
Pigeon pea	...	...	...	10 "
Groundnuts	...	...	...	8 "
Blood meal	...	...	...	4 "
Bone meal	...	...	...	1 oz. per head
Salt	...	...	...	1 $\frac{1}{4}$ " " "

The old standard for feeding calves at 1 lb. whole milk per 10 lb. liveweight has been improved, and a new system of feeding adopted. Calves are taken from the mother at birth and are fed whole milk for the first month at the rate of 1 $\frac{1}{2}$ lb. whole milk per 10 lb. liveweight. To prevent digestive troubles, due to the very high fat content of the milk, whole milk is diluted with water, 1:2—the calves are able to drink any amount of this mixture without ill effects. After the first month the calves are changed over to skim milk and concentrates, and in order to prevent any check in growth the change over is made gradually over three weeks. The concentrates are fed at 1 lb. per 10 lb. of milk fed. Weaning is done gradually over a period of three weeks when the calf is four months of age. Calves on this feeding standard put on over 1 lb. per day liveweight which is double the liveweight increase on the old standard.

84. *The Effect of Climate upon Grazing.*—A series of experiments has been started for observation on the grazing performances of cattle and their reaction to atmospheric conditions. These experiments are to be carried out at different times of the year, namely, at the height of the rains ; at the height of the dry season ; at the end of the rains ; at the end of the dry season. These experiments were planned in order to find the causes of daily fluctuations in milk yields and butterfat percentages. It was thought that high temperatures during the day might affect the grazing times of the cattle and cause bodily discomfort, thus indirectly affecting the milk yield. One experiment was completed during the change over from the rainy season to the dry season. The results are:—that at this time of the year cows graze for 12 hours (8 $\frac{1}{2}$ during the day and 3 $\frac{1}{2}$ at night) ; stand for 1 hour only during the day, not at all at night ; and lie down for 9 hours (1 hour daytime, 8 hours night). The rest of the time was spent being milked. Although body temperature, pulse rate and respiration rate increased with increasing atmospheric temperature, the increase was apparently not sufficient to cause the cattle any discomfort even at 90 degrees F., in fact they grazed throughout the hot time of the day. The higher temperatures of the dry season may have more effect.

85. *Grass Trials.*—The two grasses which withstood flooding were Guinea grass and elephant grass. The plots were cut at intervals and the weight of fodder recorded ; height measurements were taken to record rate of recovery after cutting. This will give data on the optimum number of cuts per year for each grass. Quarter acre blocks of a large variety of grasses have been established and fenced. The number of hours of grazing are recorded, and experience is being gained in the grazing management of these grasses.

86. *Goats*.—A number of goats were obtained from Kabala for breeding and selection for milk production, but a large percentage of deaths occurred due to vegetable poisoning. The Teko-bred goats, which are of the same type, were however not affected, presumably because they avoided the poisonous plants. 348 lb. 10 ozs. of milk were produced by the goats during eight months only. The average yield per goat per lactation was 55 lb. with a maximum of 101lb. The average length of lactation was 56 days with a range of from 24 to 111 days. The maximum daily yield was 2 lb. 4 ozs.

87. *Sheep*. The conformation of the sheep has been improved by the use of a ram selected for its deeper body and shorter legs. the previous ram was of the leggy "slab-sided" type which produced larger animals but of poor conformation.

88. *Poison Plants*.—In collaboration with the Veterinary Officer, the experiments with plants suspected of being poisonous to stock have been continued. So far four plants have been proved toxic and eleven non-toxic. Sheep have been used in these trials but Guinea pigs and rabbits are now being bred for this purpose.

89. *Maize Breeding*.—Local maize was grown, the cobs from the best plants selected, and then grown by the "Ear to Row" method. Forty different lines were selected and grown in this manner. Notes were made at intervals on height, bulk of leaf, tillering, date of flowering and date of harvesting. Six of the best lines were retained and have been planted for bulking in isolation plots. Selected plants from these lines will be selfed and crossed and selection continued. Even after this short time a considerable improvement is obvious.

90. *Fly Worry*. The practice of changing the bedding in the cattle pens frequently during the rains and collecting all dung dropped in the yards has practically eliminated fly worry due to *Stomoxys*.

(c) RESEARCH PLANT PATHOLOGY

91. The Plant Pathologist, Mr. F. C. Deighton, acted as Director of Agriculture from 24th June to 11th November, 1946. Mr. C. T. Pyne was appointed Laboratory Assistant on 1st January, 1946. The Plant Pathologist reported as follows:—

"1. *Rice*.—A disease of rice not previously seen in Sierra Leone, caused by a species of *Ephelis*, appeared on the experimental farm at Rokupr in the latter part of the year. The disease appeared first on Atehubu (a Gold Coast rice variety introduced in January, 1945) and on Konko (a local selection of a Sierra Leone variety) in October-November: diseased panicles were picked off and burnt. It appeared lightly, in mid-December, on Fortuno (a variety from the United States of America introduced in January, 1945) and on Sagbama (a local variety). These four varieties were growing in two lots of small randomised plots, one lot inside the empoldered area of the farm and one outside, among the following other varieties none of which were attacked: No. 79, D. 99, D. 114, Bai Sheka, Tantifo, Bagalam, Tamba Male, Lead, Sughandi, Toma 55, Toma C, Toma 112 and G.E.B. 24. At the end of December, only one or two diseased panicles were to be found on the Fortuno and Sagbama plots, whereas some 10 or 20 per cent of the Konko plants and 25-50 per cent of the Atehubu plants were attacked inside the empolder and a rather smaller proportion of these two varieties outside the empolder. As a rule, the plants had put out healthy main tillers and set good panicles; it was the later tillers which were particularly attacked.

There is thus evidence of varietal difference in susceptibility to this disease. Local Paramount Chiefs who visited Rokupr and were shown

the disease all stated that they had never seen it before. However, since the disease was not in evidence when these susceptible varieties were grown at Rokupr in 1945, it is most unlikely that the fungus is a new introduction. It seems more probable that the fungus is the common *Ephelis pallida* Pat. which has been recorded in Sierra Leone on a number of wild grasses and once on a rare wild rice, *Oryza brachyantha*, and of which the ascigerous state, where known, seems to be *Balansia andropogonis* Syd. It is therefore unlikely that the disease will normally be serious. The four rice varieties attacked in 1946 are not very well suited to conditions at Rokupr.

The *Ephelis* fungus attacks the young rice grains in particular, and in severe attacks the whole panicle becomes stuck together in a spike, covered with a white mycelial growth on which appear paler or darker brown, often elongated, discoid stromata, and later sessile brown spherical stromata, in which the spores are borne.

The *Ephelis* spores of this rice fungus agree closely with numerous previous Sierra Leone collections of *E. pallida* Pat. on various wild grasses. The *Balansia* state was found on some of the affected rice panicles at Rokupr in December and agrees well enough with previous Sierra Leone collections of *B. andropogonis* Syd. on the wild grass *Streptogyne gerontogaea*.

2. *Bean*.—Rust (*Uromyces appendiculatus*) has now become well established at Rokupr and Njala, but only the climbing French bean variety "Everbearing" is attacked, and in most seasons the yield of the plants seems to be little affected.
3. *Cowpea*.—A Cowpea (*Vigna sinensis*) variety introduced from Ceylon in May, 1946, was seen in September to be mildly attacked by an *Aecidium* not previously recorded from Sierra Leone. Because of this, and the fact that this variety of cowpea did not seem to be suited to Sierra Leone conditions, the plants were destroyed by burning.
4. *Citrus*.—Some outbreaks of citrus scab (*Elsinoe fawcettii*) were traced to an unfortunate distribution of scabby plants during the war-years.
5. *Tomato*.—Some concern was caused early in the year by unusually severe blossom-end rot of tomatoes (especially Norton variety from South Africa) at Rokupr, Batkanu, Makeni and Kabala, on plants otherwise particularly healthy and strong-growing.
6. *Damping-off of Seedlings*.—At Njala, especially during the rainy season of 1946, a considerable amount of "damping-off" occurred among seedlings in seed boxes, due to species of *Pythium*. Owing to other duties, it was unfortunately not possible for cultures to be made in most cases. *Pythium aphanidermatum* was, however, isolated from seedlings of the local cucumber (*Cucumis metuliferus*), and *P. myriotylum* from seedlings of French beans.
7. *Minor records of interest* were: *Uredo melinidis* on wild molasses grass (*Melinis minutiflora*) near Kabala; and *Cercospora calotropidis* on *Calotropis procera* in Sanda Kamaranka Chiefdom. The latter is a new record for Sierra Leone.
8. Nearly 100 collections of miscellaneous fungi and about 550 collections (including 100 by Mr. P. Adames) of flowering plants were made during the year and despatched to the Imperial Mycological Institute and the Royal Botanical Gardens, Kew, respectively, duplicates being placed in the Herbarium at Njala."

ENTOMOLOGY

92. The Entomologist, Mr. F. A. Squire, who had been seconded to the West African Cacao Research Institute at Tafo, Gold Coast, returned to Sierra Leone on 23rd December. The Laboratory Assistant, Mr. J. S. Wellington, was promoted to Senior Laboratory Assistant and continued to carry out the routine duties of the division throughout the year. The Entomologist submitted the following report:—

CROP PESTS

Rice.—The Dynastid *Heteronychus* sp. which attacks rice nearly every year was again recorded. The species was not known to the British Museum and is probably new to science. It attacks the roots and collar of the young rice plants and appears to be confined to the Sewa River rice areas just east of Turner's Peninsula. Here the rice is broadcast on wet swamp land before the advent of the rains, the grass *Pennisetum* sp. which covers the land having previously been brushed and placed in rows to mark the boundaries between the farms. This annual practice results in the accumulation of masses of decomposing vegetable matter bordering the rice farms which appear to provide ideal breeding conditions for the beetle. Fortunately the land, later in the rains, becomes flooded resulting in the destruction of the eggs, larvæ, and pupæ in the ground otherwise the damage to the crop, as it matures, might be much more severe. As it is, many of the seedlings are destroyed but this loss is probably partly made up by tillering of the remaining stands. Closely allied beetles of the same family are widely known in the tropics and sub-tropics as pests attacking the collar and root system of a variety of crops.

Cacao.—The brown cacao capsid *Sahlbergella singularis* Hagp. was observed attacking cacao in characteristic isolated pockets causing die-back and malformation as in other parts of West Africa. Neither of its true native hosts, *Cola togoensis* Engl. et Krause and *C. diversifolia* de Wild. et T. Dur., are known in Sierra Leone. The black cacao capsid *Distantiella theobroma* Dist. was taken on *Ceiba pentandra* Gaertn. and on citrus but not on cacao, nor has it ever been recorded on this crop in Sierra Leone.

Coffee.—The Lycaenid *Deudorix bimaculata* Hew. was observed attacking ripening coffee berries. The eggs are laid on the surface and the larvæ on emergence tunnel through the pulp and eat the seeds, pupating in the cavity thus formed. The adult is $\frac{3}{4}$ "–1" across, mud-brown with an orange dot on each fore-wing and orange island on the hind-wings. Succulent varieties are preferred; Liberica, Excelsa and Robusta are readily attacked whilst *Stenophylla* is avoided. Coffee is preferred to the native host, the "bush apple" *Heinsia pulchella* K. Schum. (Rubiaceae).

The larvæ of the hawk-moth *Cephanodes hylas* L. completely defoliated trees at Njala in July. The Ceratopogonid, *Forcypomyia inornatipennis* Aust. was observed in numbers feeding on the larvæ. It may be of interest to note that another species of this fly, *F. hirtipes* de Meij, has been recorded in Malaya feeding on the same moth by Corbett and Miller. In fact the genus is widely associated with Sphingid larvæ.

Citrus.—Budded nursery stocks at Njala growing near to a young silk cotton tree were severely attacked by *Distantiella theobroma* Dist.

Mango.—Grafted mangoes in the nurseries at Newton and at Njala were severely damaged by *Helopeltis* sp. which caused die-back, bunching, cankering and angular leaf spot.

PESTS OF STORED PRODUCTS

The Anthibid, *Araecerus fasciculatus* de Geer, was recorded for the first time on stored cacao in this country although it is well known in Nigeria. It appears to be indigenous to West Africa, its native host being *Morinda geminata* DC. (Rubiaceae) the fruits of which it attacks. The cosmopolitan

moth *Ephestia cautella* Wik. was also recorded for the first time on stored cocoa in Sierra Leone. Coffee beans at Kailahun and Pujehun were found infested with the Scolytid, *Cryphalus coffeae* Haged. This also is a new record for Sierra Leone.

REFERENCE COLLECTION

Five lots of insects sent for identification were returned by the British Museum. Many were new records for Sierra Leone and a few proved to be new to the British Museum."

SUMMARY OF REPORT ON THE CITRUS MOTH INVESTIGATION, OCTOBER 1942 TO JULY 1945

93. Mrs. Jordan, Entomologist, Citrus Moth Investigation, submitted a report covering the investigation from December 1942 to July 1945. In it the distribution of fruit-piercing moths and their hosts is discussed. 61,800 moths were caught on 841 nights. The common fruit piercing moths in different West African countries are compared and discussed. The greatest incidence of a large number of different species is correlated with the onset of the rains, *i.e.* in April and May. A list of larval food plants is given and there is a discussion on the parasites reared.

94. The following general discussion of the problem is taken from Mrs. Jordan's report:—

"In Sierra Leone the main citrus crop is ripe in the dry season while in the rainy season only a small and unimportant second crop ripens. This appears to agree with Southern Nigeria (Golding) but does not with the Gold Coast where the main crop is in the rainy season. The collection of moths on all ripe fruit available, rather than limiting collections to citrus, has shown that while moths known to attack citrus are present all the year round in small numbers they only reached epidemic proportions at the beginning of the rainy season, and there is considerable variation from year to year in the numbers and species which constitute these outbreaks. The loss in Sierra Leone due to damage to citrus by fruit piercing moths is therefore small and of little economic importance at present. Moths do occur however and attack, beside citrus, a large variety of other fruit; though only in the period of twelve to fifteen weeks following the first rains do they occur in such numbers as to be liable to be a serious pest. This must be borne in mind if in the future any extension of fruit-growing in this country is contemplated, either by extension of the citrus fruiting season, the utilization of other fruits in the citrus off-seasons in connexion with canning, or the growing of other fruit crops for the market. Any fruit which ripens, or approaches ripening, in the period from the last week in March to the first week in July is liable to be totally lost through moth attack. Thus if the citrus season is to be extended the fruiting must be earlier than at present rather than later. Moths not only are already known to attack a large variety of fruit, but it is very likely that they change their tastes and may attack any fruit which is sufficiently succulent. Or, on the other hand, they may leave it alone—though at any time this situation may be reversed. In the Gold Coast, carambolas are attacked heavily by moths while at Njala, although the same species of moths were present and there were ripe carambolas in abundance, no moths were caught piercing them. In the Gold Coast Box found that lemons were also attacked by moths, though Hargreaves and Cotterell had stated, for Sierra Leone and the Gold Coast respectively, that lemons were definitely not attacked. Since observations on the quite heavy lemon crop at Njala showed that they are still not attacked in Sierra Leone it will be of interest to see if in the future at any time this crop will attract moths.

The problem of these sudden outbreak of moths at the beginning of the rains is of interest in itself apart from its possible economic aspect. Hargreaves for *Achaea catocaloides*, says that migration occurs and that the first specimens caught are tattered. These observations were not repeated, in fact the opposite occurred. The first moths which appeared (*Achaea* spp) at the beginning of the rains were all very fresh and seemed to have newly emerged. These became more worn as the numbers began to reduce and it was then that outbreaks of larvae were found. A little later greater numbers of fresh moths were caught on fruit. Box observes that there is little correlation in the Gold Coast between outbreaks of moths and larvae and he suggests that this may be partly due to larvae feeding in the forest canopy. Around Njala the bush is all low and there is no forest and no canopy. Larvae present are, therefore, within easy collecting range and are plainly visible in large numbers. It would appear therefore that Box's suggestion on this point may be correct, and that larvae are present in the Gold Coast but out of reach and out of sight.

While control of moth attack is not at present of much importance in Sierra Leone the following points might be made. From observations in connexion with rainfall and moth abundance it would appear that prompt harvesting of ripe fruit in March April should be done as soon as the first storms of over one inch of rainfall occur. In this way a very much larger proportion of the crop might be saved than if harvesting was started when the moths first appear.

When cashew and mango were ripe at the same time as citrus it appeared that moths were definitely attracted to the former two fruits rather than to the citrus, and to cashew rather than mango. If, when citrus and cashew are ripe at the same time, the moths always go to cashew in preference to citrus it might be possible by planting cashew trees a short distance away from citrus greatly to reduce the attack, unless, as previously stated might happen, the moths' preference changed."

CHEMISTRY

95. This section had been closed down since 1930, but important soil problems have recently arisen in connexion with rice-growing in reclaimed swamps which have made it essential to re-establish chemical investigation at the earliest opportunity. Accordingly preliminary steps were taken in 1945 to re-equip the laboratory and to obtain an Agricultural Chemist and Assistant. In 1946, the chemical apparatus and reagents arrived and a Laboratory Assistant was appointed. A Chemist was appointed but had not arrived by the end of the year.

96. Meanwhile, the soil toxicity problem being urgent, Mr. J. M. Dent, Agricultural Officer, carried out some preliminary field and laboratory investigations in connexion with the toxic areas at Rokupr and Maswari. His first report is as follows:—

"Rokupr Rice Farm was first empoldered during the dry season of early 1944. Rice was planted in July of that year, and it soon became clear that over most of the farm a good yield was to be expected. On six blocks near the river, however, the rice died out in patches though elsewhere in the same blocks growth was good. The "dead spots" were believed to have originated through disturbances in the soil and sub-soil when the bunds were made and the blocks levelled.

2. In spite of these observations, the harvest was reassuring and some very heavy yields were recorded. The opinion was widely held that the "dead spots" would disappear gradually as the soil reverted to its natural state. It was also considered that salt in the soil was partially responsible for the failure, and that when this was washed out, all would be well.

3. In 1945, the river water was excluded during the dry season, and soon a brownish yellow substance appeared encrusting the internal bunds. Samples of soil and water from Rokupr were analysed in 1945 by Vine in Nigeria who reported both to contain considerable quantities of ferrous iron and sulphate, with a pH value of 2.6 to 3.0. After planting in 1945, it was noticed that the dead spots had extended very considerably since the previous year and that in the affected areas yields would be very poor. It was at this time that the term "toxicity" came into vogue to describe the unaccountable necrosis of the rice.

4. Simultaneously, in the Funkudeh-Luti reclaimed area, near Funkudeh all vegetation except mangrove was killed. No rice was planted in this area, but rice near the Luti sluice died in the same way as it did at Rokupr.

5. Clearly, this peculiar result of empoldering tidal swamps in the Scarcies required full investigation and no further schemes could be undertaken until the nature of the necrosis was elucidated and counter measures discovered.

6. Careful scrutiny of the records of Rokupr Farm since 1934 when the Station was opened, showed that the blocks worst affected in 1945 had always exhibited irregular differences in fertility. Throughout the old records references are made to obscure diseases of rice, occurring in small patches, and characterised by symptoms which appear identical with those observed when large areas of rice died in 1945. Typical manifestations were that the leaves turned a rusty colour, the plants were stunted, and that they frequently died. In the affected areas the soil became red in colour, and often red algae occurred.

7. It appears, therefore, that small toxic patches have been present on Rokupr Farm at least since 1934. Until 1945, the areas were so small, or the total effect was so slight, that no apprehension was experienced. Similar patches in the Scarcies are known by the natives, who avoid planting in these areas. The catastrophe of 1945 caused great alarm especially as the phenomenon was believed to be entirely new. In fact, the toxic areas originally present had spread to such an extent that they could no longer be overlooked.

8. Early in 1946, steps were taken to investigate the chemical relationships of the toxic substances. Analyses of soil samples and water samples from affected blocks showed that in all cases, the acidity was high, and that there were high concentrations of iron and sulphate. Most of the iron occurred in the ferrous state, but some had become oxidised to the ferric form. The concentration of chloride, which at one time had been the suspected cause of toxicity, was very low.

9. The high acidity of Scarcies swamp soils and the solvent effect of the acid on iron compounds, was observed by Glanville and Doyne (1933). They did not apparently find sulphate present. They further noted the acidity was highest in newly cleared mangrove swamps and that even where the land had been cultivated for many years, the sub-soil remained acid, though the top 6 inches became nearly neutral.

10. In 1937, Doyne, working on cleared mangrove swamp in Nigeria found that the pH of these soils fell rapidly when exposed to the air, that red furruginous streaks appeared, and that ferrous iron and sulphate were produced. He believed that the acidity and presence of sulphate were due to oxidation of ferrous sulphate, thus producing sulphuric acid.

11. This observation was repeated in 1946 at Rokupr. A portion of black Scarcies mud was exposed to the air. In four weeks the pH had fallen to 4 and ferrous iron plus sulphate begun to appear. It was further noted at Rokupr and Maswari that the presence of mangrove roots seemed to be correlated with the incidence of toxicity. Mangrove roots exposed to the air when cuttings and drains were made became rusty in colour, and water draining from them was highly toxic.

12. Mr. Pollett, Government Geologist, when on a visit to Rokupr, stated that he had found deposits of iron pyrites in conjunction with decaying mangrove vegetation in the Colony Peninsula. The state of affairs then seemed clearer.

13. Empoldering in the Scarcies had modified natural edaphic factors. During the dry season, when the river water was saline, water was kept off the land. This created a continuous oxidising phase compared with the natural alternate oxidising and reducing phases brought about by tidal inundation. The result was that the oxidation of ferrous sulphide (or pyrites) was facilitated and toxic concentrations of iron and sulphate accumulated.

14. It was realised at this stage that the failure of rice at Maswari in 1943, when irrigation water failed, was due not to salt, but to the same toxic substances. *Avicennia* and *Rhizophora* mangrove both occur at Maswari. The roots of both species contain iron, but in areas where *Avicennia* once stood, the toxicity seems to be of a less permanent nature. This is borne out by the fact that the 1946 crop at Maswari is even and healthy in the areas where the vegetation had been *Avicennia*.

15. A corollary of the association of mangrove with toxicity is that the condition is potentially worse along the banks of rivers or creeks where mangroves formerly flourished. There is little or no danger on areas that were formerly grass swamps.

16. Practical steps to combat the problem in the Scarcies were taken in 1946. Half of block 7 (which had been toxic) was flood-fallowed with fresh water from January to March, and the remainder kept dry. The crop was better on the flood-fallowed half than upon the control half. (Cf. 2,123 lb. per acre from flood-fallowed half with 178 lb. per acre from remainder).

17. Block 22 was flooded with saline tide water from April onwards. However, no subsequent improvement in soil condition occurred and the yield was little better than in 1945 (36 lb. per acre compared with 12½ lb. per acre). On the five other blocks near the river the yields were without exception poorer than in 1945.

18. Small empolders were built near the river bank to compare (a) water control in the wet season (b) water control in the dry season (c) full control (d) no water control. The experiment began on 15th June. The results in the first season are anomalous. However, no reliable information can be expected until several years have passed. Yields in 1946 were:—

(a)	2	bushels	44	lb.
(b)	4	"	58	"
(c)			44	"
(d)	3	"	39	"

19. Finally, a strip extending across Block 26 was limed with quick lime at the rate of 5 tons per acre. This procedure was successful in countering toxicity, but is of academic interest only as at present there is no cheap, natural supply of lime in Sierra Leone."

97. These investigations appear to indicate that the occurrence of toxic areas in empoldered tidal swamps is correlated with the distribution of ferrous iron in naturally highly acid soils. There is some evidence to show that the type of the original vegetation—i.e. grasses and sedges; *Rhizophora* mangrove or *Avicennia* mangrove—may be of importance when selecting swamp areas to be reclaimed for rice cultivation by methods involving empoldering and water control. Considerable further investigation and experiment are needed before reaching any final conclusions.

98. In addition to soil toxicity research, analyses were made of various poultry and cattle foods, whilst preliminary laboratory work was done in the preparation of fruit juices.

(d) PRODUCE INSPECTION

99. With the exception of the first quarter of the year Mr. C. G. White, Assistant Inspector of Produce, was in charge of the Produce Inspection Branch throughout the year. Mr. A. F. MacKenzie, Agricultural Officer, was in charge for the first quarter. The Inspection staff consisted of fourteen permanent and five temporary examiners. Inspection covered all the main rail, river and road buying points, and was chiefly concerned with palm kernels, ginger and piassava. Although the tonnage of produce at any one point might be comparatively small the large number of buyers and the scattered nature of their stores made inspection exacting work for the relatively few examiners. That their work was done adequately is borne out by the absence of complaints from overseas importers of Sierra Leone produce during 1946. This has been particularly noticeable in the case of ginger and piassava, commercial reports upon which have been very favourable. In 1947, it is hoped that the arrival of an Inspector from England and the appointment of more African examiners will enable inspection to be even more complete and thorough by including every type of exportable product and improving storage conditions. Co-operation between the Produce Inspection Branch and the Field staff of the department has been close and effective. In this way instructional work amongst producers of ginger, piassava and cocoa has been correlated and strengthened by the work of the produce examiners.

100. The foundation of inspection work is the Produce Inspection Ordinance. During 1946 this was completely overhauled and revised in the light of experience gained in Sierra Leone combined with legislation found effective in other British West African Colonies. With this, in effect, new and stricter Ordinance coming into force in the latter part of the year results, particularly in the piassava trade, have been immediate.

101. A piassava scheme, in charge of the Agricultural Officer, Bonthe, was put into operation at the beginning of the year in the Sherbro area whereby instructors worked amongst producers improving methods of cutting, retting and preparation, whilst produce examiners tightened up inspection at the buying points. By the end of 1946 all sub-standard piassava was under control and its purchase and export forbidden. The result has been that the high quality of pre-war prime Sherbro piassava has been recovered, and, according to latest reports, is beginning to be surpassed. Whilst this scheme was being developed additional new Agricultural Instructors and Produce Examiners were trained in the Sherbro District with a view to drafting them into the Sulima area as soon as they were experienced and as soon as the new Produce Ordinance came into effect. Sulima area, prior to the war, produced the bulk of piassava exported from Sierra Leone. It was of a lower standard than prime Sherbro but was in good demand. In the last quarter of the year, selected instructors and examiners, trained in Sherbro, were sent to the Sulima area and under the charge of the Agricultural Officer, South-western Circle, instructional and inspection work there was organized on lines similar to those found effective in the Sherbro scheme. Results have been educative both to producers and buyers and there is every sign that the whole piassava industry, as far as production and quality are concerned, is now being developed on sound lines.

102. There was a record year in 1946 both for price and tonnage of piassava exported: 4,118 tons valued at £236,352 being shipped as compared with 1,110 tons valued at £44,024 in 1945. The previous highest tonnage was in 1939 when 3,907 tons valued at £38,900 were exported. The previous highest value was in 1942 when 3,200 tons were exported with a value of £119,887. The 1946 price per ton was however exceptionally high and a more normal period is to be expected once the United Kingdom demand has been met. Accordingly

every effort is being made, now that quality is assured, to find new overseas markets. In this connexion the Imperial Institute has reported upon samples and is obtaining information as to possible markets and their requirements.

103. Other work of the Produce Inspection Branch included checking of weights and weighing machines and prosecuting where necessary. In addition, prosecutions were instituted for offences against the Produce Inspection Rules.

104. The tonnage of the main export crops inspected by the branch in 1946 was:—

				<i>Tonnage</i>	<i>Value</i> £
Palm kernels	...	...	...	46,773	688,840
Ginger	...	...	...	982	51,819
Piassava	...	...	...	4,118	236,352
Total ...				51,873	977,011

(e) AGRICULTURAL EDUCATION

105. The training of Agricultural Instructors continued at the Njala Training College, now in its eighth year. Agricultural teaching throughout the year was in charge of Mr. T. P. Wheldon, Agricultural Officer, who was assisted from March onwards by Mr. J. A. Austin, Agricultural Officer. Since its inception the College has provided 32 Agricultural Instructors for the department, whilst during 1946 two groups of students were under training and took the agricultural course. The senior group comprised twelve students who successfully passed their second year examination in July and proceeded to the third year of the course. They will complete the course in November, 1947. The junior group comprising ten students took the first year of the course. The educational standard of this group was considerably higher than any previous admissions and progress was very satisfactory.

106. The following summarises the syllabus of agricultural lectures:—

First Year :

The major subjects are soils, botany, climate and vegetation, surveying, arithmetic, English and labour management.

Second Year :

Provides for instruction in soils and plant ecology, crop husbandry, elementary zoology, with particular attention to the productive and digestive systems of domestic and farm animals, surveying and building, elementary mathematics and English.

Third Year :

Soils, crops, animal husbandry (nutrition and management), zoology, with particular reference to insects and means of control, surveying and building, elementary mathematics and English.

Fourth Year :

Animal husbandry, general agriculture, cropping systems, manures, erosion (methods of control), animal nutrition, surveying and levelling, produce and marketing, elementary mathematics and English.

107. All the teaching in the major subjects is strictly related to agriculture. The curriculum avoids any temptation to spend too much time upon purely theoretical aspects of science, and guards against the danger of keeping science and agriculture in water-tight compartments. Emphasis is laid on the application of every scientific fact presented during lectures.

108. A great part of the time is spent in practical work on the college and departmental farms. The college farm cultivated under a system of contour strip cultivation is divided into six annual and six permanent strips. The annual strips are cultivated once every six years and are then planted with elephant grass to allow for regeneration. Broadcasting of mixed crops on the lines of native practice is carried out on the strip under cultivation in each year. The six permanent strips of cash crops comprise citrus, oil palm, coconut palms, bananas and plantains, coffee and mixed fruit trees. Seedlings for the various strips are raised in the college nurseries. Seeds of varieties of upland rice are collected from different parts of the country and raised in order to study distinctive characteristics. Other crops grown and studied include yams, pigeon pea, cocoyam, beniseed, maize, guinea corn and okra.

109. A poultry improvement scheme is maintained under which Rhode Island Red and native birds are run on open range and under a trap-nesting system, particular attention being paid to the laying performances of native fowls. The Livestock section includes some cattle, on loan from the Department of Agriculture, and rabbits. The students thus become used to the handling, rearing and feeding of livestock at an early stage.

110. The students carry out chain and compass surveys and prepare plans of local swamps. During their course they pay regular visits to the departmental farm and nurseries, and spend some time at the stock farm at Teko, taking part in the practical work of the farm and receiving lectures from the Veterinary Officer. For the last six months of their course the students are posted to Agricultural stations and work under the direction of the Agricultural Officer in charge.

111. The work on the college farm is carried on throughout the year under the supervision of the students. Each month a student bailiff is appointed and, with the assistance of a student overseer for each section of the farm (poultry, cattle, permanent crops, annual crops, nursery, compound upkeep, etc.), organises the work, being allowed a certain amount of money to be spent on labour for the month. The students who do not hold office work as labourers on the farm for three hours a day. In addition each student has his own garden in which to carry out his own ideas. By the end of the course each student submits an original thesis on a selected aspect of local agriculture.

R. R. GLANVILLE,
Director of Agriculture.

DEPARTMENT OF AGRICULTURE,
NJALA, VIA MANO.

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